ERDC/CERL SR-04-5

Construction Engineering Research Laboratory

US Army Corps of Engineers®
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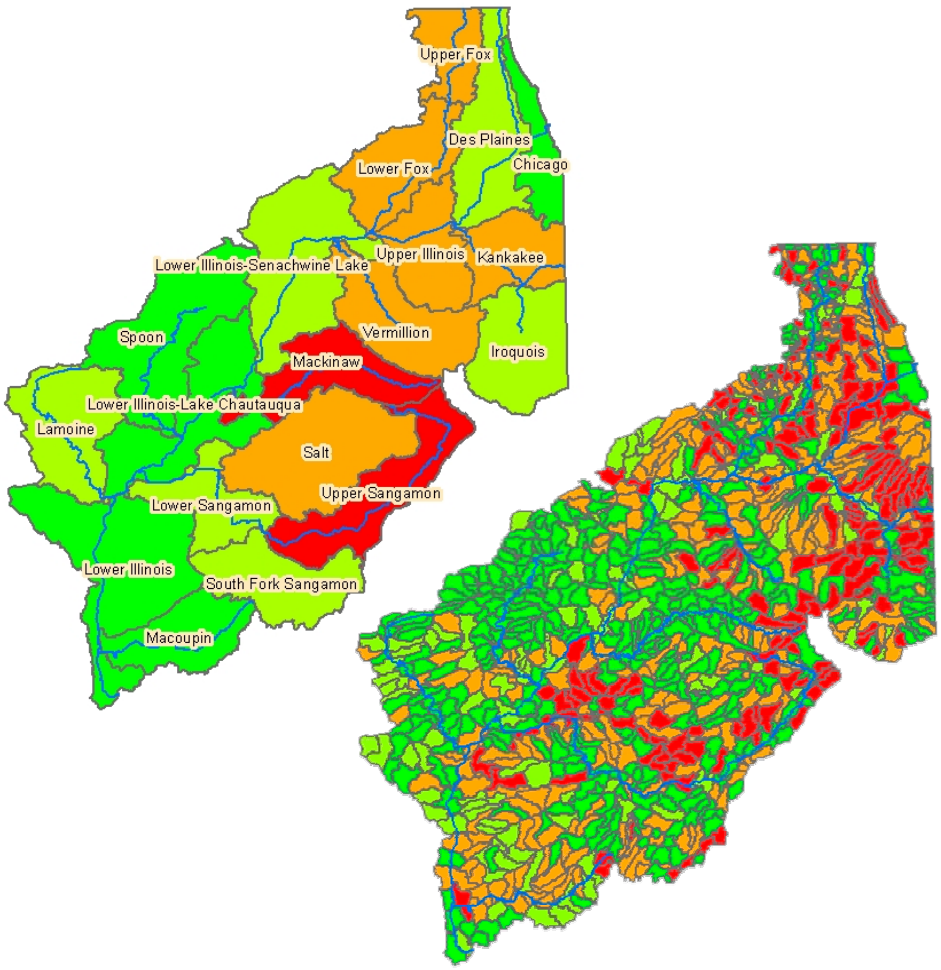
User Manual
Illinois River Restoration Needs Assessment GIS

RNA-GIS

Scott A. Tweddale

April 2004



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User Manual Illinois River Restoration Needs Assessment GIS: RNA-GIS

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Final Report

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000

Under CNC-QA01

ABSTRACT: The Illinois River RNA-GIS application and geospatial database were developed as a tool to support the Illinois River Ecosystem Restoration Feasibility Study – Restoration Needs Assessment (RNA). Its purpose is to assist in the evaluation of historic, existing (primarily), predicted future, and desired future conditions of the Illinois River Watershed by providing an extensive geospatial database and customized GIS analytical capabilities. The study area and extent of the associated geospatial database includes the mainstream Illinois River, its tributaries, and watershed. The application is structured to provide access to GIS themes at three different scales: (1) the Illinois River Watershed, (2) the major tributary watersheds [USGS Hydrologic Unit Code-8 (HUC-8)], and (3) the subwatersheds [USGS Hydrologic Unit Code-12 (HUC-12)]. This method of organizing the application and geospatial database supports data browsing, data queries, and summaries at all scales in support of large-scale planning and smaller-scale, site-specific project formulation. The Illinois River RNA-GIS application was created using Environmental Systems Research Institute (ESRI) ArcGIS8.X® software and Microsoft's Visual Basic for Applications® (VBA), which is included with ArcGIS8.X products.

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Preface

This study was conducted for the U.S. Army Corps of Engineers, Rock Island District under Reimbursable project "Illinois River Restoration Needs Assessment GIS," Work Unit CNC-QA01, "In-House Technical Performance for GIS Tools and River Hydrology Modeling." The technical monitor was Mr. Charles H. Theiling, CEMVR-PM-A.

The work was performed by the Ecological Processes Branch (CN-N) of the Installations Division (CN), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Scott A. Tweddale. The technical editor was Gloria J. Wienke, Information Technology Laboratory. Steve Hodapp is Chief, CEERD-CN-N, and Dr. John T. Bandy is Chief, CEERD-CN. The associated Technical Director was Dr. William D. Severinghaus, CEERD-CV-T. The Director of CERL is Dr. Alan W. Moore.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL James R. Rowan and the Director of ERDC is Dr. James R. Houston.

Acknowledgements

The author thanks the following people and organizations for contributing data, reports, and information that were critical to the development of the geospatial dataset that was compiled as part of this project.

Kingsley Allan, Illinois State Water Survey

Kathleen Brown, Illinois State Water Survey

Tom D'Avello, USDA-Natural Resources Conservation Service

David Day, Illinois Department of Natural Resources

Kelly Dilks, U.S. Army Corps of Engineers, ERDC-CERL

Katherine Hunter, Illinois Natural History Survey

J. Christopher Jennings, Illinois State Water Survey

Marilyn Ruiz, University of Illinois, College of Veterinary Medicine

Liane Suloway, Illinois Natural History Survey

Diane Szafoni, Illinois Natural History Survey

Tari Weicherding, Illinois Natural History Survey

Carolyn White; University of Illinois; College of Agriculture, Consumer, and Environmental Sciences; Information Technology and Communication Services

1 Introduction

Background

The Illinois River RNA-GIS application and geospatial database were developed as a tool to support the Illinois River Ecosystem Restoration Feasibility Study – Restoration Needs Assessment (RNA). Its purpose is to assist in the evaluation of historic, existing (primarily), predicted future, and desired future conditions of the Illinois River Watershed by providing an extensive geospatial database and customized GIS analytical capabilities. The study area and extent of the associated geospatial database includes the mainstream Illinois River, its tributaries, and watershed.

The Illinois River RNA-GIS application is structured to provide access to GIS themes at three different scales: (1) the Illinois River Watershed, (2) the major tributary watersheds [USGS Hydrologic Unit Code-8 (HUC-8)], and (3) the subwatersheds [USGS Hydrologic Unit Code-12 (HUC-12)]. Similarly, a large number of geospatial data layers in the GIS have been summarized for each HUC-8 and HUC-12 watershed within the larger Illinois River Watershed. There are 19 HUC-8 watersheds and 944 HUC-12 watersheds in the Illinois River Watershed (Figures 1 and 2). This method of organizing the application and geospatial database supports data browsing, data queries, and summaries at all scales in support of large-scale planning and smaller-scale, site-specific project formulation.

System Requirements

The Illinois River RNA-GIS application requires ESRI ArcGIS8.X* software (ArcView8.X, ArcEditor8.X, or ArcInfo8.X) to function and will not run within Workstation ArcInfo or ArcView3.X. Specific hardware requirements are listed on the ESRI Internet site: http://www.esri.com/.

* ArcGIS is a commercial software product from Environmental Systems Research Institute (ESRI), 380 New York Street, Redlands, CA 92373-8100, telephone: 1-909-793-2853.

Figure 1. HUC-8 watersheds in the Illinois River Watershed.

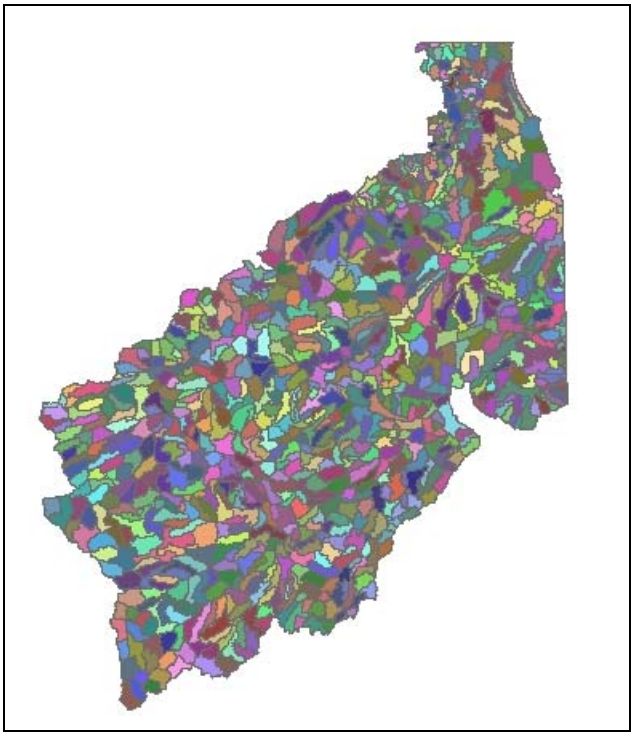

Figure 2. HUC-12 watersheds in the Illinois River Watershed.

Technical Background

The Illinois River RNA-GIS application was created using Environmental Systems Research Institute (ESRI) ArcGIS8.X software and Microsoft's Visual Basic for Applications® (VBA), which is included with ArcGIS8.X products. ESRI ArcGIS8.X (ArcGIS Desktop) software is available in three different products, listed in order of increasing capability and functionality: ArcView8.X, ArcEditor8.X, and ArcInfo8.X. All three products share the same architecture and user interface. More importantly, all ArcGIS8.X products include a suite of three separate but integrated applications: ArcMap, ArcCatalog, and ArcToolbox. The Illinois River RNA-GIS application runs within ArcMap and has been customized using VBA. Customizations include additional command buttons and tools that provide customized functionality that is not available in the standard ESRI ArcGIS8.X ArcMap application. Customizations also include standard layouts for map output. The Illinois River RNA-GIS application will run in any of the ArcGIS8.X products (ArcView8.X, ArcEditor8.X, and ArcInfo8.X) because the application runs within the ArcMap application, which is included in all ArcGIS8.X products.

ArcMap allows customizations of the interface to be stored at three different levels. The Normal Template (**Normal.mxt**) is where you store personal customizations. The Base Template **(*.mxt**) stores customizations that are made accessible to any user who opens a map using this Base Template or opens a map that was produced from this Base Template. Customizations may also be stored in the current map document **(*.mxd**), but they are available only for that map document.

Customizations for the Illinois River RNA-GIS are stored in a base template named **IllinoisRiver_RNA.mxt**. This file can be loaded onto your system using the installation instructions in Chapter 2, Installing the Application and Data.

Technical Notes

The Illinois River RNA-GIS provides customized functionality, but also retains all functionality of ESRI ArcGIS8.X software. Therefore, the interface should support both novice and experienced ArcGIS8.X software users. The customized functionality was designed to facilitate common GIS data browsing, queries, and analysis at the HUC-8 and HUC-12 watershed scales within the Illinois River Watershed. Therefore, users with no experience or training with ArcGIS8.X software should be able to conduct these common GIS tasks using the customized functionality of the interface. Customized functions and examples of

common tasks are described in detail in Chapter 4, Interface Elements and Chapter 5, Interface Task Descriptions. However, this documentation does not provide a complete overview of ArcGIS8.X software. Although all functionality of ArcGIS8.X is available from within the interface, refer to ESRI ArcGIS8.X software documentation for a detailed description of the functionality of ArcGIS8.X software. Some of the tasks that can be completed using the customized functionality of the interface can also be completed using basic ESRI ArcGIS8.X software. For these tasks, the interface simply provides a more direct and simple method for completing such tasks. Other functions within the interface are unique to the interface.

A comprehensive geospatial dataset was compiled to support the customized interface. However, the dataset is simply a collection of standard ArcGIS8.X feature datasets (coverages, shapefiles, grids, tables), and therefore is available for query and analysis using the standard ArcGIS8.X software functions. Although all geospatial data has been summarized for both HUC-8 and HUC-12 watersheds in the Illinois River Watershed to support the customized interface, most of the original geospatial data layers are also included in this data set. Data were acquired from a variety of state and federal agencies. All data layers include the metadata files that document the original source of the data. These files are compliant with standards of the Federal Geographic Data Committee (FGDC).

Two coverages that were created specifically for the Illinois River RNA-GIS application, *huc8_master* and *huc12_master*, are critical to the functionality of the interface. Both coverages contain a record for each HUC-8 (or HUC-12) watershed, and a large number of fields or attributes that summarize a specific theme for each record or watershed. Many of the customized command buttons and tools within the interface require that one of these coverages (*huc8_master* or *huc12_master*) is in the current data frame and is also selected. See Chapter 5, Interface Task Descriptions for a more detailed explanation of how these specific coverages are used within the RNA-GIS application.

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Because the huc8_master and huc12_master are standard ArcGIS coverages, they may be analyzed outside of this specific application using standard ArcGIS functionality.

2 Installing the Application and Data

Customizations for the Illinois River RNA-GIS are stored in a base template named **IllinoisRiver_RNA.mxt**. This file can be loaded onto your system using the installation instructions below.

The Illinois River RNA-GIS application requires ESRI ArcGIS8.X software (ArcView8.X, ArcEditor8.X, or ArcInfo8.X) to function and will not run within Workstation ArcInfo or ArcView3.X.

Installing the Application (IllinoisRiver_RNA.mxt Template)

The **IllinoisRiver_RNA.mxt** template can be loaded into any disk location on your system. However, the data directory that contains all data created for this application must be loaded at the same location as the **IllinoisRiver_RNA.mxt** template (see Installing the Data, page 6).

Although the **IllinoisRiver_RNA.mxt** template can be loaded in any disk location, it is recommended that you load the template as follows.

1. Navigate to the Templates directory in the location where your ESRI ArcGIS8.X software is installed. For example: C:\arcgis\arcexe81\Bin\Templates
2. Create a new directory under Templates called "IllinoisRiver."
   Although a new directory is not necessary to run the application, by creating this directory in the templates directory, an "IllinoisRiver" Tab will be created automatically in the ArcGIS template startup dialog box. Therefore, you will not need to browse the file system looking for the template at startup, but instead will be able to access the **IllinoisRiver_RNA.mxt** template directly under the "IllinoisRiver" Tab (see Accessing and Starting the Application, page 9). In addition, if you have multiple templates that you intend to use, this provides a good method for organizing and accessing different templates.

3. Place the **IllinoisRiver_RNA.mxt** template in the new IllinoisRiver directory. Using the above examples, the file would be in the following location:
C:\arcgis\arcexe81\Bin\Templates\IllinoisRiver\IllinoisRiver_RNA.mxt
This location will vary according to the location where the ESRI ArcGIS8.X software is installed on your system.

The IllinoisRiver_RNA.mxt file CANNOT be renamed. The application has a built-in function to automatically detect where the template (and data) are loaded on your system. Renaming the IllinoisRiver_RNA.mxt file will cause this function and the entire application to fail.

4. In addition to the **IllinoisRiver_RNA.mxt** template, two additional templates have also been created: **illriver.landscape.mxt** and **illriver.portrait.mxt**. These templates are for map layout purposes only, and do not contain any customization related to the functionality of the application. Therefore, they should not be opened directly in the ArcGIS8.X startup dialog box. Instead, either template can be selected as an alternative template for printing map output while in layout view within the application. They are simply templates or "starting points" for producing map output in a landscape layout (**illriver.landscape.mxt**) or portrait layout (**illriver.portrait.mxt**). For more information on these templates, see Preparing Output, page 33).

   Both of these templates (**illriver.landscape.mxt** and **illriver.portrait.mxt**) should be loaded in the same location as the **IllinoisRiver_RNA.mxt** template (see step 3 above).

Installing the Data

The Illinois River RNA-GIS dataset consists of many individual data layers or "maps" in a variety of standard ESRI ArcGIS8.X data formats, including shapefiles, coverages, grids (raster), layers, and tables. All data must be stored in a Data directory on your system. The "Data" directory can be loaded into any disk location on your system by following the instructions below.

1. Create a "Data" directory under the "IllinoisRiver" directory that was created when you installed the application. If you have not already created an "IllinoisRiver" directory, please go back and complete that process first.

Note that the file extension for all ArcMap map documents is *.mxd, while the extension for all ArcMap templates is *.mxt. It is important to distinguish between these two types of files when opening and closing ArcMap documents.

2. Load all data files (i.e., coverages, shapefiles, grids, layers, tables) and directories (e.g., 07120001) into this new "Data" directory. With the exception of the three template files (***.mxt**) discussed earlier, all remaining files on the software media are data and should be loaded into the "Data" directory.

NOTE: Data for the Illinois River RNA-GIS exists on three (3) CDs.

NOTE: The complete Illinois River RNA-GIS dataset requires approximately 1.55GB of disk space. If you do not have 1.55GB of disk space in a single location on your system, you can divide the data and load it onto several different disks or disk partitions, or even access it directly from CD. However, there are several "core" data files (e.g., coverages, shapefiles, layers) that **MUST** be loaded into the Data directory that is in the same location as the **IllinoisRiver_RNA.mxt** template. These data layers are required for the application to function properly. If these files are not loaded into the Data directory, or if they are renamed, certain functions within the interface will fail. Table 1 lists these data layers. Other background data layers can be loaded in different locations.

Table 1. Data layers that MUST be loaded into the Data directory.

All sub-directories for individual HUC-8 Watersheds (e.g., 07120001)
huc8_master (Coverage)
huc12_master (Coverage)
huc8.shp (Shapefile)
huc12.shp (Shapefile)
Inter_BSC.shp* (Shapefile)
Inter_riparian8.shp* (Shapefile)
Inter_riparian12.shp* (Shapefile)
Landcover.lyr (Layer File)
*** Files marked with an asterisk have been preprocessed (i.e., are output from an intersection of two map layers) to facilitate faster processing time for certain functions. These files CANNOT be renamed.**

NOTE: ArcCatalog, which is a standard application that is provided as part of ArcGIS8.X, is a useful tool for file management (e.g., copy, rename, remove, etc.) and browsing of ESRI data files (coverages, shapefiles, grids, layers, tables) and metadata. ArcCatalog functions very similar to Microsoft Windows Explorer®, but is customized for managing ESRI data formats. Many ArcGIS data layers are actually comprised of several individual files (e.g., coverages). By using ArcCatalog for file management, an entire coverage, including all of its supporting files can be copied, renamed, or removed in a single step. Using MS Windows Explorer® or some other file browser would require you to copy, rename, or remove each individual support file that is part of a coverage. You may find ArcCatalog useful for copying Illinois River RNA-GIS data files from the CDs to the "Data" directory.

3 Interface Initialization

Accessing and Starting the Application

The Illinois River RNA-GIS application is stored in an ESRI ArcGIS base template (**IllinoisRiver_RNA.mxt**). For instructions on how to install the Template, please refer to instructions in Chapter 2, Installing the Application and Data, page 5. You must have ArcGIS8.X (including ArcMap) installed on your system to run the Illinois River RNA-GIS application.

Opening the **IllinoisRiver_RNA.mxt** template initializes the Illinois River RNA-GIS application. Follow the instructions below to open the **IllinoisRiver_RNA.mxt** template.

1. Start ArcMap by double-clicking on the ArcMap shortcut on your desktop.
2. An ArcMap startup dialog box should appear (Figure 3.)
   Select "A Template" (as shown) and click OK.

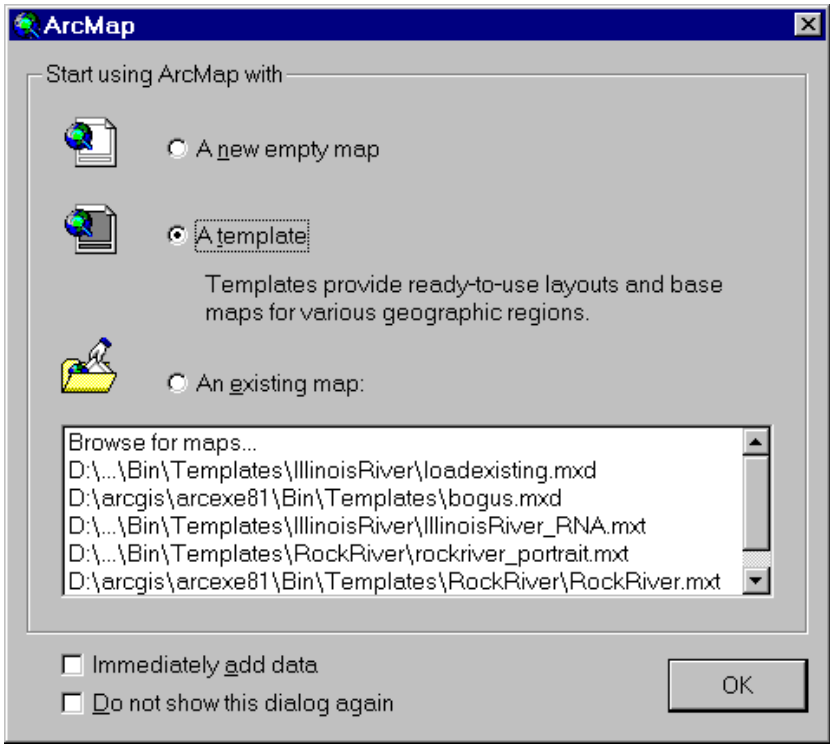


Figure 3. ArcMap startup dialog box.

3. A "New" template startup dialog box should appear (Figure 4).

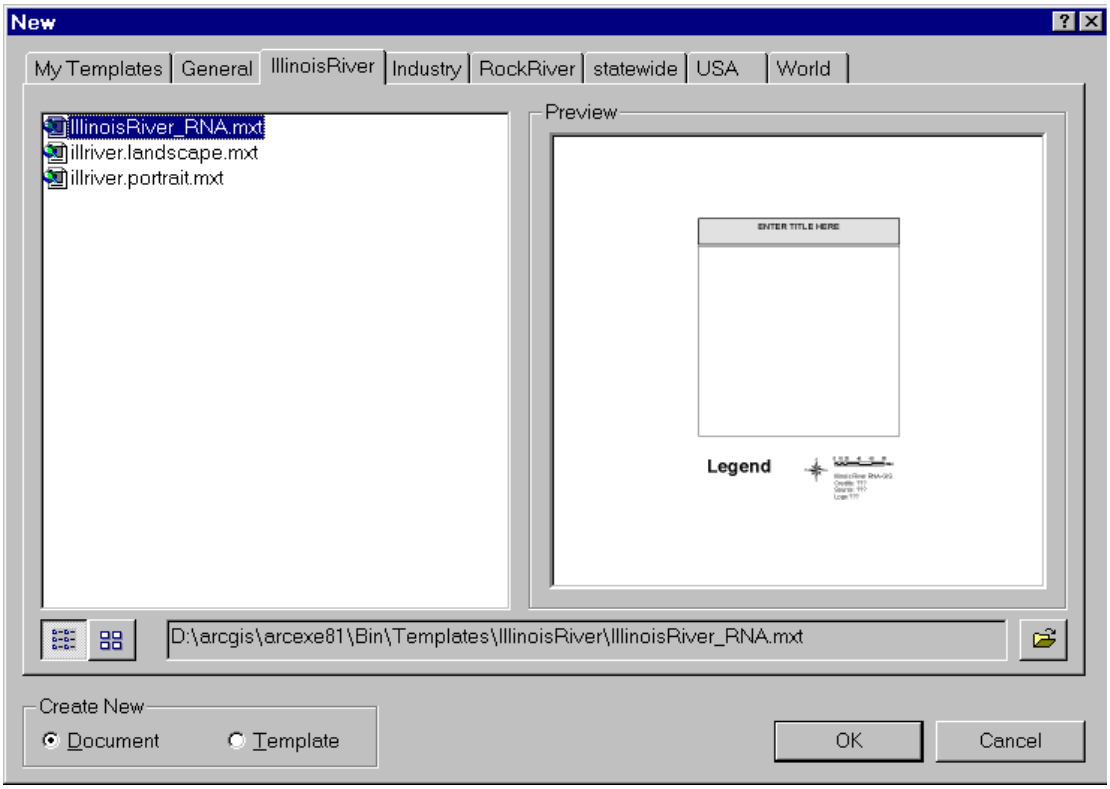


Figure 4. A new template startup dialog box.

This window (Figure 4) should have a tab at the top labeled "IllinoisRiver." Click on this tab, and then select **IllinoisRiver_RNA.mxt** by either double-clicking on it or by single clicking on it and then clicking OK.

If an "IllinoisRiver" tab does not appear, then the directory was not created according to the installation instructions. Refer to Chapter 2, Installing the Application and Data, page 5 for instructions on installing the application template (**IllinoisRiver_RNA.mxt**). Once the template is installed, refer to page 9 for instructions on how to access and start the application.

If you opted to install the **IllinoisRiver_RNA.mxt** template elsewhere on your system because of disk space constraints or personal preferences, you will need to select the browse button and navigate to the location where you installed the **IllinoisRiver_RNA.mxt** template. Again, it is not a requirement to create an "IllinoisRiver" directory in the ArcGIS8.1 Templates directory (see page 5).

However, by doing so, an "IllinoisRiver" Tab will be automatically created in the "New" template startup dialog box (see Figure 4, page 10).

You should always access the Illinois River RNA-GIS application by selecting "Template" in the ArcMap startup dialog box, or by browsing to the location of the IllinoisRiver_RNA.mxt template and selecting it directly.

You MUST open new map documents using this template for the application to function properly. Once you have opened a map using this template and saved it as a map document, the customizations will be stored directly in that map document. Therefore, you can open map documents saved from the template directly instead of opening them from the template, and all customizations and functionality of the application will be accessible (see Exiting the Application, page 12).

If you open the IllinoisRiver_RNA.mxt template by using the File>Open drop-down menu within another ArcMap map document, the Application will fail and you will see a warning that the template should be initialized from the ArcMap startup dialog box.

However, if you want to make changes to the template itself, whether it be changes to the Visual Basic code, or simple revisions to the placement, appearance, and docking of command buttons, toolbars, and tools, then you MUST open the IllinoisRiver_RNA.mxt template using the File>Open drop-down menu from within another ArcMap map document.

After starting the template as described above, you will see a "Welcome to the Illinois River RNA GIS" startup window that will prompt you to select either HUC-8 or HUC-12 watersheds for analysis, or to load an existing map (Figure 5). Select one of these options and then click on OK to create a new ArcMap map document that is based on the IllinoisRiver_RNA.mxt template. At this point, all customized command buttons, toolbars, tools, and layouts are functional.

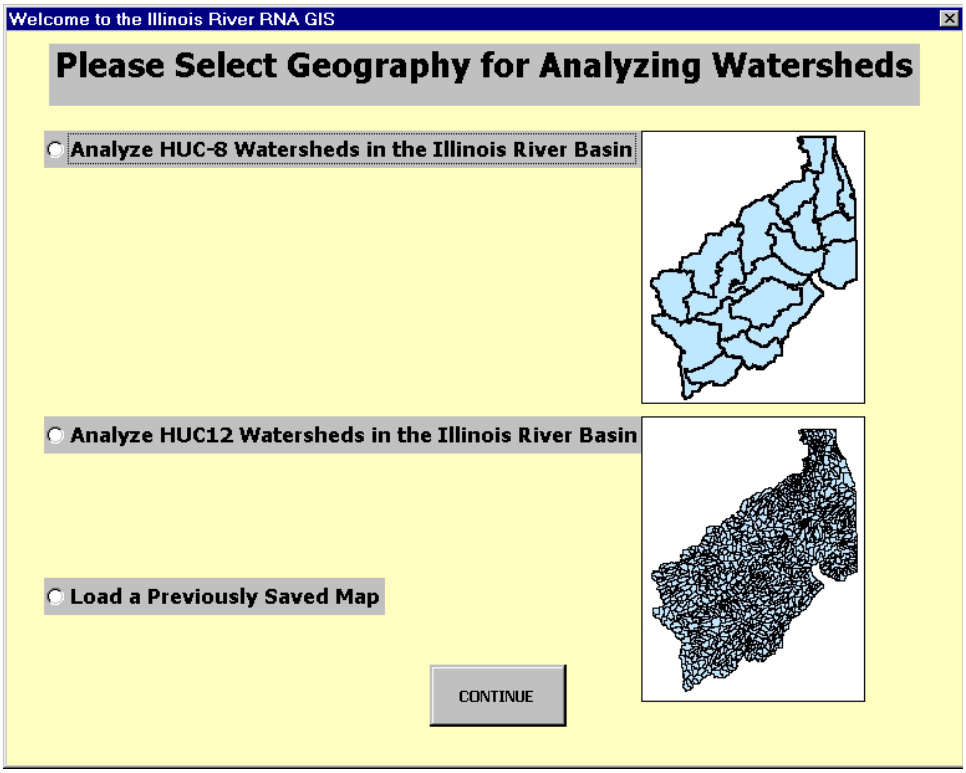


Figure 5. Initial Illinois River RNA-GIS startup screen.

Exiting the Application

The Illinois River RNA-GIS application creates a new ArcMap map document (***.mxd**) when the application is initialized. The ArcMap document (***.mxd**) is based on the ArcMap template (**IllinoisRiver_RNA.mxt**).

The new ArcMap map document is titled "Untitled" by default. If you conduct analysis using the Illinois River RNA-GIS application and want to save that map document, save it just as you would save any other ArcMap map document.

To save the ArcMap map document:

1. Click on the Save File Button or
2. Use the File Menu and select Save or Save As.

Similar to other Microsoft Windows® applications, if you attempt to exit the software without first saving the map document, you will be prompted to save the document (or save changes to the document). Also similar to other MS Windows® applications, if you have created a new file, you will be prompted for a new file name and disk location to save the file. The saved map will be an ArcMap map document, and NOT an ArcMap template. This may be confusing if

you are not familiar with templates, as most users expect the saved map to be a template instead of a map document.

In general, you typically work with ArcMap map documents (***.mxd**). Templates are used to store custom functionality and layouts. You would rarely open an ArcMap template directly, unless you want to modify the customizations stored in the template by editing the VBA code or modify the appearance, location, and docking properties of command buttons, toolbars, and tools. Instead, you would generally open an ArcMap map document (***.mxd**) based on an ArcMap template (***.mxt**). By default, any map document that is opened is based on the **Normal.mxt** template. However, by specifying a different template (e.g., **IllinoisRiver_RNA.mxt** for the this application) prior to opening a map document, that document (***.mxd**) is then based on that specific template and inherits all of the customization associated with that template. By specifying and opening a template at startup (Figures 3 and 4), you are not really opening a template, but rather opening a new map document based on that template.

Once you have opened a map document based on a specific template (e.g., **IllinoisRiver_RNA.mxt**), any customizations in that template are stored directly in the map document (***.mxd**). Therefore, you can open the map document directly in the future, instead of opening the document by referencing a template.

For example, the first time you open the Illinois River RNA-GIS application by accessing the **IllinoisRiver_RNA.mxt** template, you may save the resulting map document to the file **MyMap.mxd**. When you want to reopen **MyMap.mxd**, you can open it just as you would any other map document. All of the customizations in the **IllinoisRiver_RNA.mxt** template will be embedded in the **MyMap.mxd** map document.

It is not necessary to follow the steps outlined in Accessing and Starting the Application on page 9 to open a previously saved map document (e.g., **MyMap.mdx**). However, if you do follow the steps to open the document by accessing the **IllinoisRiver_RNA.mxt** template first, there is an option in the startup screen "Welcome to the Illinois River RNA GIS" that allows you to load a previously saved map document (Figure 5, page 12). If you do open the map document directly instead of opening via a template, you will not be greeted with the startup screen, but all other customizations will be functional in the map document.

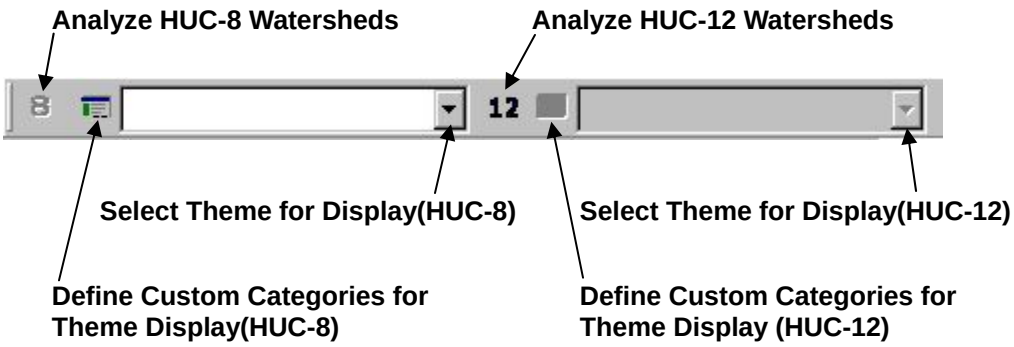
Note that the file extension for all ArcMap map documents is *.mxd, while the extension for all ArcMap templates is *.mxt. It is important to distinguish between these two types of files when opening and closing ArcMap map documents and templates.

In addition to saving the entire map document (***.mxd**), there are several options for saving analysis results within the Illinois River RNA-GIS Application, including exporting maps to ESRI layer (***.lyr**) files and multiple standard graphic formats (e.g., jpeg, gif, tiff, etc.).

4 Interface Elements

The Illinois River RNA-GIS interface includes three toolbars that contain customized command buttons, tools, and list boxes. It also includes one customized tool that is added to the standard ArcMap toolbar. Again, in addition to these customizations, all standard ArcMap toolbars and their respective commands, tools, menus, and lists are also functional from within the interface. A graphic and brief description of each customized toolbar and individual command buttons, tools, list boxes are included below. A more detailed description of the functionality of each customized utility is provided in Chapter 5, Interface Task Descriptions, page 21.

Data Browse Toolbar



Analyze HUC-8 Watersheds
Analyze HUC-12 Watersheds

Toggle buttons allow you to select analysis of HUC-8 or HUC-12 Watersheds.

NOTE: In the above graphic, HUC-8 is currently selected; therefore, the command button is deactivated.

Select Theme for Display (HUC-8)
Select Theme for Display (HUC-12)

These list boxes allow you to select a theme to display in the active data frame, for either HUC-8 or HUC-12 watersheds, depending on which scale you currently have selected. Default category breaks are predefined in the interface to facilitate rapid and simple browsing of the geospatial dataset. However, you are allowed to define custom category breaks (see the following paragraph).

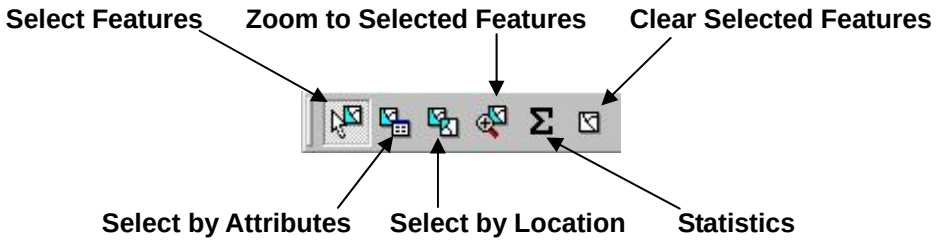
NOTE: In the above graphic, HUC-8 is currently selected; therefore, the Select Theme for Display (HUC-8) is activated and the Select Theme for Display (HUC-12) is deactivated. Themes can be displayed only for the currently selected watershed analysis scale (HUC-8 or HUC-12).

Define Custom Categories for Theme Display (HUC-8)
Define Custom Categories for Theme Display (HUC-12)

These command buttons allow you to define custom category breaks for the selected theme. You may define and display 2 to 5 custom categories for a map theme.

NOTE: In the above graphic, HUC-8 is currently selected; therefore, the Define Custom Categories for Theme Display (HUC-8) is activated and the Define Custom Categories for Theme Display (HUC-12) is deactivated. Custom category maps for themes can be displayed only for the currently selected watershed analysis scale (HUC-8 or HUC-12).

Selection/Query Toolbar



All functionality of the command buttons and tools on the Selection/Query Toolbar are available within the standard ArcMap interface in ArcGIS8.X. They have not been customized using VBA. However, none of these command buttons are made available by default on the standard toolbars provided within ArcGIS8.X, with the exception of the Select Features on the standard ArcMap toolbar. Therefore, they were all added as command buttons to a single Selection/Query Toolbar to facilitate easy access.

Select Features

This tool allows you to graphically select features in any map layer currently displayed in the active display.

Zoom to Selected Features

This command button zooms the display extent in the active display to the smallest geographic extent that includes all selected features. At least one feature must be selected for this command button to be activated.

Clear Selected Features

This command button clears all selected features. At least one feature must be selected for this command button to be activated.

Select by Attributes

This command button opens a dialog box that allows you to select features by queries on multiple attributes and multiple map layers in the active data frame. A selection wizard is also accessible from within this dialog box.

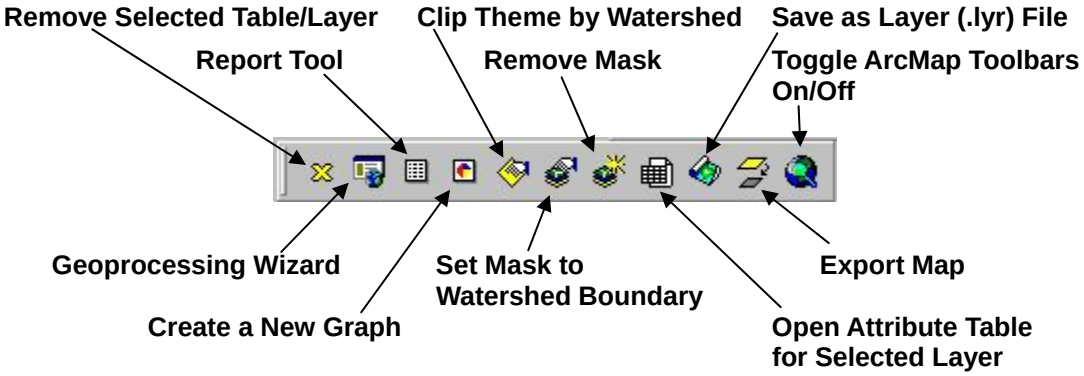
Select by Location

This command button opens a dialog box that allows you to select features based on their location relative to other features for one or multiple attributes and/or map layers in the active display.

Statistics

This command button opens a dialog box that allows you to compile descriptive statistics for selected features. At least one feature must be selected for this command button to be activated.

Geoprocessing/Analysis Toolbar



Remove Selected Table/Layer

This command button removes the currently selected layer or table in the table of contents. The table of contents provides a list of all forms, data layers, and tables within the map document.

Clip Theme by Watershed

This command button allows you to clip any map theme by the boundary of a specified watershed. A map of HUC-8 or HUC-12 watersheds (depending on which analysis scale you currently have selected) is displayed in the active data frame and you are prompted to click on the "Select HUC" tool to graphically select an HUC-8 or HUC-12 watershed to define the clip boundary. You are then provided a file selection dialog box to select the map layer to be clipped (see Select HUC8/HUC12 Watershed Tool, page 20).

NOTE: The file selection dialog box expects an ArcGIS8.X Feature Class to be selected as the input map layer to be clipped. When clipping shapefiles, you can select the shapefile. However, when clipping coverages, you must specifically select the feature class. The feature class is dependent on the type of coverage being clipped (point vs. line vs. polygon). If you are clipping a point coverage, you must select the point feature class within the coverage directory. If you are clipping a line coverage, you must select the line feature class within the coverage directory. If you are clipping a polygon feature class, you must select the polygon feature class within the coverage directory. Grids are not feature classes, and therefore cannot be clipped using this customized command button. Grids must be clipped using the ArcGIS8.X Spatial Analyst.

Save as Layer (.lyr) File

This command button allows you to save the currently selected map layer in the table of contents as a layer (**.lyr**) file. A layer file allows you to save a customized legend or color table for a specified map layer.

Report Tool

This command button opens a dialog box that allows you to compile customized reports on attributes in all map layers in the active data frame. The "Report Tool" command button is a standard ArcGIS8.X function. It has not been customized with VBA. However, the "Report Tool" command button is not made available by default on the standard toolbars provided within ArcGIS8.X.

Remove Mask

This command button allows you to remove any mask that was set using the "Set Mask to Watershed Boundary" command button.

Toggle ArcMap Toolbars On/Off

This command button toggles other ArcGIS8.X toolbars on or off. Exceptions are the ArcMap Main Menu, Standard toolbar, Layout toolbar, and Drawing toolbar.

Geoprocessing Wizard

This command button opens the Geoprocessing Wizard dialog box. The Geoprocessing Wizard is a standard ArcGIS8.X function. It has not been customized with VBA. However, the Geoprocessing Wizard is not made available as a command button by default on the standard toolbars provided within ArcGIS8.X. The Geoprocessing Wizard provides a wizard interface to Dissolve, Clip, Merge, Intersect, or Union map layers.

Set Mask to Watershed Boundary

This command button allows you to define a mask as the boundary of any specified HUC-8 or HUC-12 watershed. All data in the current display that is outside of the "mask" boundary will not be displayed, while all data within the "mask" boundary will be displayed. A map of HUC-8 or HUC-12 watersheds (depending on which analysis scale you currently have selected) is displayed in the active data frame and you are prompted to click on the "Select HUC" tool to graphically select a HUC-8 or HUC-12 watershed to define the mask boundary. The display in the active data frame is refreshed with a mask in place. The display is also zoomed to the smallest geographic extent that surrounds the watershed boundary defining the mask.

IMPORTANT NOTE: The mask that is created by this command button affects the graphic display ONLY. The mask **DOES NOT** affect the attribute table itself or any subsequent analysis, queries, or reports.

Export Map

This command button allows you to export the contents of the active data frame to various graphics formats (e.g., jpeg, tiff, etc.) to facilitate import and export of graphics to other software applications. A dialog box is opened to allow you to select a disk location, file name, and graphic format for the exported file.

Create a New Graph

This command button allows you to create a graph in various formats that depict information and summaries of records and/or fields of any map layer in the active data frame. A wizard prompts you to provide all necessary input for displaying the graph. The "Create a New Graph" command button is a standard ArcGIS8.X function. It has not been customized with VBA. However, the button is not made available as a default on the standard toolbars provided within ArcGIS8.X.

Open Attribute Table for a Selected Layer

This command button opens the attribute table of the currently selected map layer in the table of contents.

Select HUC8/HUC12 Watershed Tool (Added to standard ArcMap Toolbar)

Select HUC8/HUC12 Watershed Tool

This tool allows you to select a specific watershed from a map of watersheds in the display. This tool is used in conjunction with other command buttons and list boxes to complete a task. Any task that requires you to select a specific watershed from a map in the display will prompt you to click on this tool and then select a watershed. Such tasks including clipping to a watershed, setting a mask to a watershed, or displaying themes by a specified watershed from the Select Themes for Display listbox.

NOTE: This tool does not become activated until another command button, tool, or list box is selected, which requires you to select a specific watershed from the display. Like other tools in the standard ArcMap interface, once the tool is selected, it is turned on and remains on until a different tool is selected. Therefore, when you are prompted by the interface to "Click on the Select HUC Tool," it may already be "On," in which case you can simply select a watershed from the display. If the interface prompts you to select this tool and it is not "On," then you must click on the tool first to turn it "On" and then select a watershed from the display. In either case, the watershed is selected from the display with a left-click inside the watershed boundary.

5 Interface Task Descriptions

This chapter provides examples of common functionality of the Illinois River RNA-GIS interface. It does not include a complete overview of all functionality of the interface. Again, in addition to the customized functionality of the interface, all standard functionality of ArcMap within ArcGIS8.X is also available. Refer to ESRI ArcGIS8.X software documentation for a detailed description of the functionality of ArcGIS8.X software, including ArcMap.

Two coverages that were created specifically for the Illinois River RNA-GIS application, **huc8_master** and **huc12_master**, are critical to the functionality of the interface. These coverages contain a record for each watershed (HUC-8 or HUC-12, as appropriate), and a large number of fields or attributes that summarize a specific theme for each record or watershed.

Many of the customized command buttons and tools within the interface require that one of these coverages (**huc8_master** or **huc12_master**) is in the current data frame and is selected. The interface is designed to allow you to toggle between analysis of HUC-8 and HUC-12 watersheds. Depending on which analysis scale you have currently selected (HUC-8 vs. HUC-12), either the **huc8_master** coverage or the **huc12_master** coverage MUST be in the active data frame and MUST be selected. All customized interface commands and tools will automatically add the appropriate coverage to facilitate the functionality of the command or tool. In many cases, the **huc8_master** or **huc12_master** is automatically added to the active data frame (if not already in the active data frame), but it is not made visible by default. The customized commands and tools DO NOT require that one of the master coverages be visible. However, most commands and tools require one of the master coverages to be SELECTED. The interface DOES NOT automatically select one of the master coverages. Therefore, you MUST select the coverage by clicking on the file name in the table of contents of the active data frame. Those commands and tools that require one of the coverages to be selected will not execute if you attempt to execute them without first selecting the appropriate coverage in the table of contents. Instead, you will be instructed to select the appropriate coverage in the table of contents.

Data Browsing

Browsing Themes Summarized by Watershed

A total of 41 themes for HUC-8 watersheds and 40 themes for HUC-12 watersheds in the Illinois River Watershed have been summarized and are available for browsing. Themes have been summarized into quantitative categories (e.g., acres, percent of watershed, percent of total stream length, etc.) and default category rankings have been assigned to facilitate rapid and simple data browsing of the various themes. Although most themes are common to both HUC-8 and HUC-12, there are some themes that are unique to one or the other. Themes are unique because the source data was available only at one of these scales, or in some cases, was available for HUC-11 watersheds, in which case it could be aggregated only to HUC-12 watersheds.

A specific theme can be viewed in the active data frame on the display by following these steps:

1. Specify the desired watershed scale for viewing by either specifying this in the initial interface initialization dialog for new map documents (see Figure 5, page 12) or by clicking on the "Analyze HUC-8 Watersheds" (or "Analyze HUC-12 Watersheds") command button (see Data Browse Toolbar, page 15).
2. Depending on which coverage you select, either the **huc8_master** or **huc12_master** coverage will be automatically added to the active display and the table of contents. The master coverage does not have to be visible in the map display. Visibility of map layers in the display is controlled by checking the box next to the layer in the table of contents. However, one of the master coverages must be SELECTED by clicking on the map layer name in the table of contents. If a coverage is not selected, you will be prompted to select one before proceeding. Select the **huc8_master** file by left-clicking on the file name in the table of contents.
3. Select a theme from the list by using the drop-down "Select Theme for Display (HUC-8)" (or "Select Theme for Display (HUC12)") [see Data Browse Toolbar, page 15]. This will automatically render the **huc8_master** (or **huc12_master**) coverage to default quantitative categories for the selected theme.

NOTE: While in the HUC-8 mode, only HUC-8 themes can be displayed. While in HUC-12 mode, only HUC-12 themes can be displayed. To toggle between modes, repeat Steps 1 and 2.

In the following example, HUC-8 was selected as the desired watershed scale (Step 1). Using the drop-down "Select Theme for Display (HUC-8)" list box, "Bio Sig Streams %" (biologically significant) was selected as a theme (Figure 6). The **huc8_master** coverage is automatically rendered to display both the map (Figure 7.) and default quantitative categories in the table of contents (Figure 8).

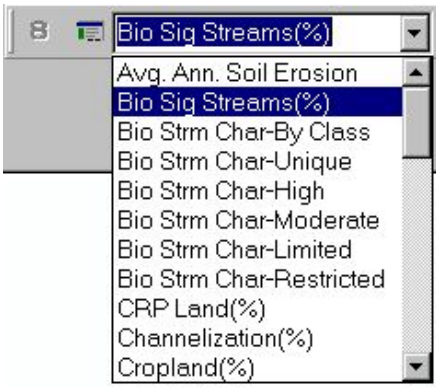


Figure 6. Select theme list box.

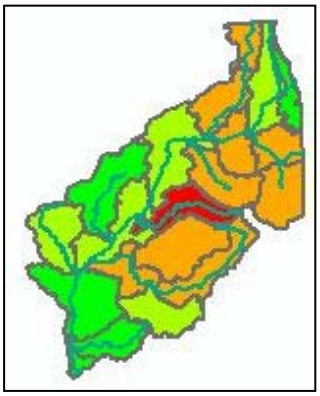


Figure 7. Display example of "Bio Sig Streams %."

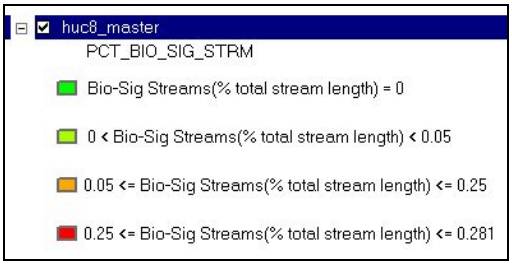


Figure 8. Table of Contents for "Bio Sig Streams %."

Displaying User-Specified Categories for Themes Displayed by Watershed

As mentioned on page 22, themes have been summarized into quantitative categories (e.g., acres, percent of watershed, percent of total stream length, etc.) and default category rankings have been assigned to facilitate rapid and simple data browsing of the various themes. However, the interface allows you to input specific category rankings in place of the default rankings.

Using the above example, Biologically Significant Streams are displayed as a percentage of total stream length and displayed using four default category rankings. You may specify to display the same theme using anywhere from two to five categories, and may also specify the upper and lower boundaries of the

category rankings. In this example, the Biologically Significant Streams will be displayed using only two categories defined as 0-10% and greater than 10%. This can be accomplished by the following steps:

1. Repeat steps 1 through 3 (on page 22). This will result in the same output as the example provided above. However, if you are specifying custom categories and category rankings for the theme that was just displayed using default categories and category rankings, it is not necessary to repeat steps 1 through 3. If you are specifying custom categories for a different theme, then the steps must be repeated.
2. Click on the "Define Custom Categories for Theme Display (HUC-8)" command button, located directly to the left of the Select Theme for Display list box (see page 15).
3. A dialog box will open that will prompt you to select the number of unique categories to display (Figure 9). In this example, select "2" and click CONTINUE.
4. Depending on how many categories you specify, a dialog box will open that will prompt you to provide break points for the number of categories specified (Figure 10). The minimum of the first category and maximum of the last category are predetermined from the range of values for the theme selected. The category break points you enter must be within the minimum and maximum, and cannot overlap. If the category break points you enter do not meet this criterion, you will be alerted and prompted to reenter the break points. Once all break points are entered and meet the criteria, click Continue. In this example, enter ".10" and click Continue.
5. A 2-category map of Biologically Significant Streams is added to the active display with Category 1 displaying watersheds with Biologically Significant Streams comprising less than 10% of the total stream length in the watershed (green), and Category 2 displaying watersheds with Biologically Significant Streams comprising greater than or equal to 10% of the total stream length (red) (Figure 11).

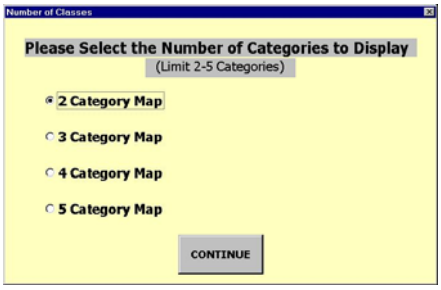


Figure 9. Select number of categories.

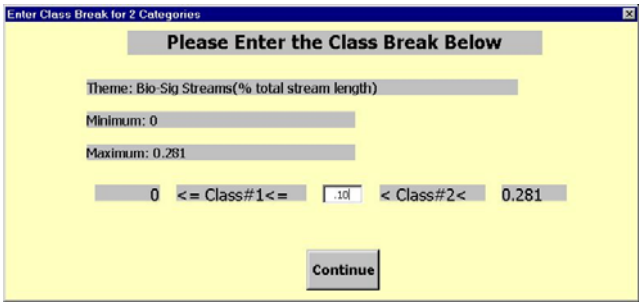


Figure 10. Define category breaks.

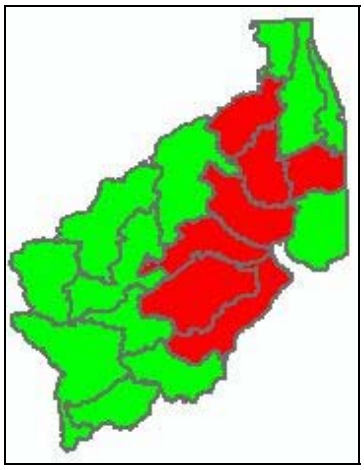


Figure 11. Display example of two categories of "Bio Sig Streams 5."

Displaying Themes by Class for a Specific Watershed

All themes for all HUC watershed scales can be displayed using the same steps. However, the themes listed below are unique. They are displayed by class or category for a specific HUC watershed, rather than displaying a comparison of all watersheds by theme. In addition, summary tables and graphs are created and displayed automatically for these unique themes.

Unique Themes

Bio Strm Char – By Class (Biological Stream Characterization by Class)
Landcover – By Class
Riprn-Bankside – By Class (Bankside Riparian Landcover by Class)
Riprn-300m – By Class (Riparian Landcover [300m buffer around stream channel] by Class)

The above themes can be viewed in the active display by the following steps:

1. Repeat steps 1 through 3 on page 22.
2. If one of the unique themes listed above is selected, a map of watershed boundaries will be automatically displayed in the active display. You will be prompted to "click on the Select HUC8/HUC12 Watershed Tool." Click on this tool in the ArcMap Standard Toolbar (if tool is not already "On"). Select a watershed in the display by left clicking within the boundary. The name (for HUC8 watersheds) or the 12-digit HUC code (for HUC12 watersheds) will be echoed to the screen. You must click "OK" to proceed.

   NOTE: All other standard ArcMap tools are available during this process. If you want to pan or zoom the active display, for example, you may do so prior to clicking the Select HUC8/HUC12 Watershed Tool to select a specific watershed.
3. The active display will be updated to display the selected theme "by class" for the specified watershed and will be zoomed to the smallest geographic extent that contains the watershed boundary.
4. A dialog box will be displayed that prompts you for a filename for a summary report. This file will contain a tabular report of the total sum of area (acres) or length (miles) for each category present within the selected watershed. The file will be saved as a dBase Table file in the same directory that contains the **huc8_master/huc_12_master** coverages and other geospatial data layers associated with the Illinois River RNA-GIS. The summary report is automatically added to the table of contents for the active display and opened in the display. In addition, a chart that graphically summarizes the summary report is also added to the display.

   NOTE: You may elect to not create and display the summary table and chart by selecting CANCEL in the output file dialog box.

In the following example, "Bio Str Char – By Class" was selected as a theme. The Select HUC8/HUC12 Watershed tool was used to select the "Lower Fox" HUC-8 watershed. Biological Stream Characterization By Class is displayed for the Lower Fox watershed in the active display (Figure 12). In addition, "Lower Fox Biological Stream Characterization" was entered as a filename for the summary report. The summary report was automatically added to the table of contents and opened in the active display (Figure 13). A chart was also added to the display (Figure 14).

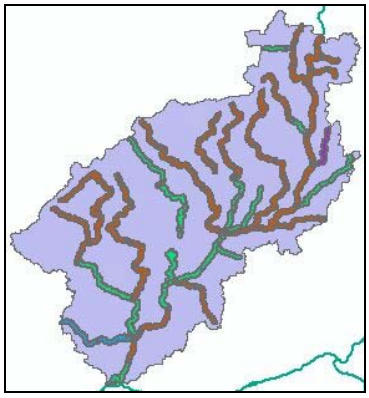


Figure 12. Biological stream characterization by class.

Attributes of Lower Fox Biological Stream Characterization

	OID	Max_RESOUR	Sum_MILES
▸	0	1-UNIQUE	16.53
	1	2-HIGHLY VALUED	164.12
	2	3-MODERATE	310.81
	3	4-LIMITED	9.43

Record: 1 Show: All Selected Records (of 4)

Figure 13. Summary report for "Lower Fox Biological Stream Characterization."

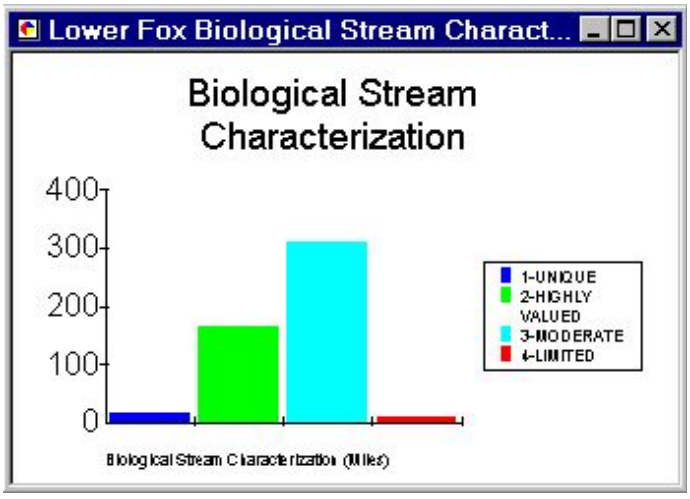


Figure 14. Summary chart. For "Lower Fox Biological Stream Characterization."

Data Selection/Queries

All of the functionality of the command buttons and tools on the Selection/Query Toolbar are available within the standard ArcMap interface in ArcGIS8.X. They have not been customized using VBA. However, none of these are made available as command buttons by default on the standard toolbars provided within ArcGIS8.X, with the exception of "Select Features" on the standard ArcMap Toolbar. Therefore, they were all added to a single Selection/Query Toolbar to facilitate easy access. Refer to the ESRI ArcGIS8.X software documentation for a detailed description of the functionality of these commands and tools within ArcMap.

An example is provided below that uses these tools to query on multiple attributes that have been summarized for all HUC-8 and HUC-12 watersheds in the Illinois River RNA-GIS. In this example, all HUC-8 watersheds are identified and selected that meet the following criteria: >75% of the watershed is cropland **AND** >25% of the watershed has been identified as a "Resource Rich Area." This can be accomplished by the following steps:

1. Select HUC-8 as the watershed analysis scale. By doing so, the **huc8_master** coverage will be added to the active display if it was not already in the active display.
2. Click on the "Select by Attributes" command button on the Selection/Query Toolbar (see **page** 16). This will open a "Select by Attributes" dialog box (Figure 15.)
3. In the layer drop-down selection list, select the "huc8_master" polygon coverage (Figure 15).
4. In this example, a new selection is being created. Therefore accept the default "Create a New Selection" in the Method drop-down selection list (Figure 15).
5. In the "Fields" selection list, double-click on the "PCT_CROPLAND" field. Click on the ">" button, then enter ".75". Click on the **And** button. In the "Fields" selection list, double-click on the "PCT_RESRICH" field. Click on the ">" button, then enter ".25".

Note the query statement that is created in the query statement text box.

6. Click the **Apply** button. All watersheds meeting these criteria are selected and highlighted in the active display (Figure 16.). In this case, only one HUC-8 Watershed – Kankakee, met the criteria. If the attribute table for the **huc8_master** file were opened, the record corresponding to the Kankakee HUC-8 watershed feature would also be selected and highlighted.

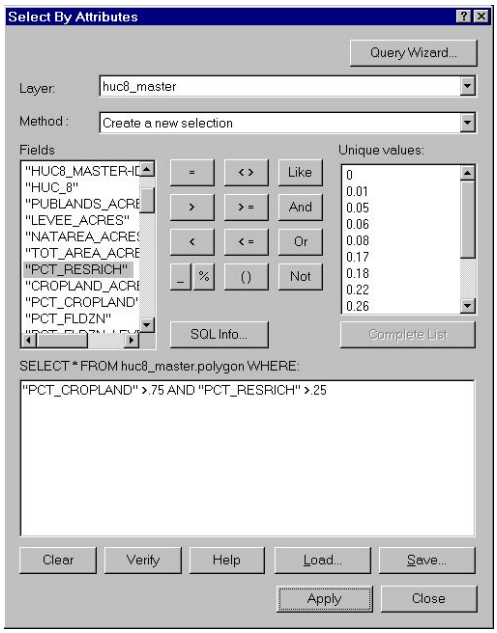


Figure 15. "Select by Attributes" dialog box.

Figure 16. Selection display for >75% cropland and >25% resource rich.

Geoprocessing and Analysis

The Geoprocessing/Analysis Toolbar contains a combination of command buttons and tools that were customized for the Illinois River RNA-GIS and functions that are available within the standard ArcMap interface of ArcGIS8.X, but are not available as command buttons in the default toolbars. Functions that are available from within the standard ArcMap interface are the Geoprocessing Wizard, Report Tool, Create a New Graph, and Export Map. They have simply

been made available as command buttons and added to the Geoprocessing/Analysis Toolbar. A brief explanation of these functions is provided in this documentation (see Geoprocessing/Analysis Toolbar, page 17). However, refer to documentation for ArcMap within ArcGIS8.X for detailed documentation of these functions. Detailed examples of their use are not provided here.

Similarly, customized command buttons such as "Remove Selected Table/Layer" and "Open Attribute Table for Selected Layer" are self-explanatory; therefore, examples of their use are not provided. Both of these commands work only on the "Selected" layer in the table of contents. The "Remove Selected Table/Layer" command does not prompt you to confirm the removal of a selected layer, so this should be used with caution. Also, this command will remove only feature layers and tables, but not grids.

The "Clip Theme by Watershed" and "Set Mask to Watershed Boundary" command buttons are customized and unique to the Illinois River RNA-GIS. Therefore, examples of their use are provided below.

Clipping

Any feature class (shapefile or coverage) can be clipped to any watershed boundary using this tool. In this example, a line coverage (streams) is clipped to the boundary of the Mackinaw Watershed (HUC-8). Clipping can be accomplished using the following steps.

1. Click on the "Set Mask to Watershed Boundary" command button (see page 17). A map of HUC-8 or HUC-12 watersheds (depending on which analysis scale is currently selected) is displayed in the active data frame and you are prompted to click on the Select HUC8/HUC12 Watershed tool.
2. Click on the Select HUC8/HUC12 Watershed tool (if tool is not already "On", see page 20) and then left-click within the boundary of the watershed that will be used to define the clip boundary. After selecting the watershed, the interface will echo the watershed name (HUC-8) or 12-digit HUC Code (HUC-12). In this example, left-click inside the Mackinaw Watershed boundary in the active display and select OK when the watershed information is echoed to the screen.
3. A file selection dialog box opens to allow you to select the map layer to be clipped (Figure 17). The file selection dialog box expects an ArcGIS8.X feature class to be selected as the input map layer to be clipped. When clipping shapefiles, you can select the shapefile directly. However, when clipping coverages, you must specifically select the feature class. The feature class is dependent on the type of coverage being clipped (point vs. line vs. polygon). If you are clipping a point coverage, you must select the "point" feature class within the coverage directory.

If you are clipping a line coverage, you must select the "arc" feature class within the coverage directory. If you are clipping a polygon coverage, you must select the "polygon" feature class within the coverage directory. Grids are not feature classes, and therefore cannot be clipped using this customized command button. Grids must be clipped using the ArcGIS8.X Spatial Analyst. In this example, a stream line coverage will be clipped. Because the streams file is a coverage of type "line," you must navigate to the coverage and then select the "arc" file to clip (Figure 17). A coverage is actually a directory containing a number of separate files that, when combined, created the coverage. Simply selecting the coverage name will not work, and in fact, a dialog box will not allow you to proceed until the actual feature class file (in this example, "arc") is selected.

4. After selecting the feature class to clip, a dialog box will prompt you for an output file name. This will be the name of the output shapefile that will be created as a result of the clip. The shapefile will be saved in the same directory that contains the **huc8_master/huc_12_master** coverages and other geospatial data layers associated with the Illinois River RNA-GIS. The new shapefile will also be automatically added to the active display and the table of contents. In this example, a new shapefile containing only streams within the Mackinaw Watershed boundary was created and added to the active display (Figure 18.)

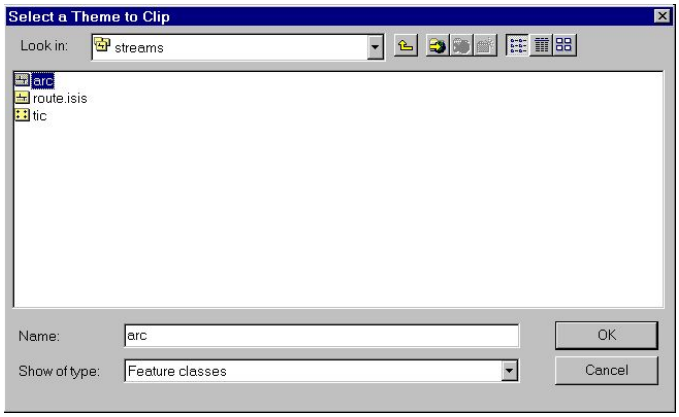


Figure 17. Clip input map file selection dialog box.

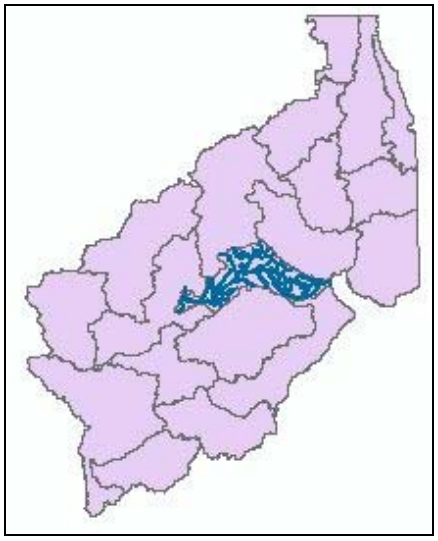


Figure 18. Display example of the Mackinaw Watershed boundary.

Masking

The "Set Mask to Watershed Boundary" command button (see page 17) allows you to define a mask as the boundary of any specified HUC-8 or HUC-12 watershed. All data in the current display that is outside of the "mask" boundary will not be displayed, while all data within the "mask" boundary will be displayed. You can create a mask by using the following steps:

1. Click on the "Set Mask to Watershed Boundary" command button (see page 17). A map of HUC-8 or HUC-12 watersheds (depending on which analysis scale is currently selected) is displayed in the active data frame and you are prompted to click on the Select HUC8/HUC12 Watershed tool.
2. Click on the select HUC8/HUC12 Watershed tool (if tool is not already "On", see page 20) and select a HUC-8 or HUC-12 watershed by left-clicking inside the watershed boundary on the active display. The display in the active data frame is refreshed with a mask in place. All themes that were in the active display prior to setting the mask are now displayed only for those areas inside the watershed boundary (Figure 19). The display is also zoomed to the smallest geographic extent that surrounds the watershed boundary defining the mask. The mask will remain in place until you remove it using the "Remove Mask" command button. In the example below, a "mask" was set to the Lamoine Watershed boundary.

IMPORTANT NOTE: The mask that is created by this command button affects the graphic display ONLY. The mask DOES NOT affect the attribute table itself nor any subsequent analysis, queries, or reports.

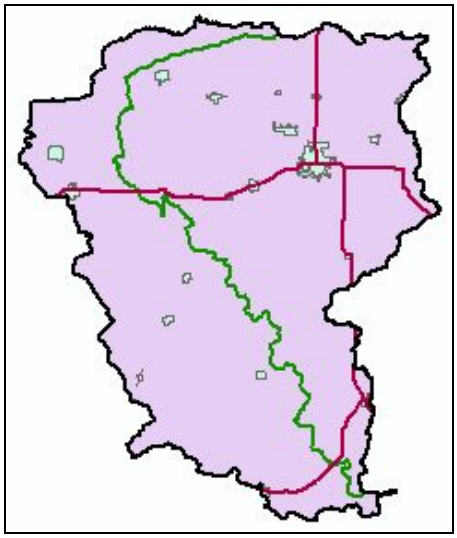


Figure 19. Display of themes in a mask.

Preparing Output

The Illinois River RNA-GIS does not have any customized functionality for preparing maps for output, with the exception of two predefined layouts stored in templates, which are explained below. However, all functionality that is available within the standard ArcMap interface of ArcGIS8.X is accessible from within the Illinois River RNA-GIS interface. Therefore, "layout view" in the standard ArcMap interface is used for map design and layout in the Illinois River RNA-GIS application. Some basic examples of the functionality available within layout view are presented below. In addition, limitations associated with the functions in layout view that are unique to the Illinois River RNA-GIS interface are also outlined below. Refer to ESRI ArcGIS8.X software documentation for a detailed description of the functionality available within layout view in the standard ArcMap interface.

The standard ArcMap interface allows you to work in one of two modes: data view and layout view. Typically, all analysis, processing, and editing of geospatial data is conducted while in data view. Layout view is used to complete the design and layout of final map products, including not only the design and layout of the map information itself, but also all of the associated map elements, such as legends, reports, charts, and scale. Most of the functionality of the ArcMap interface is accessible, regardless of whether you are operating in data view or layout view, although some menus, command buttons, and toolbars are only available in one mode or the other. You can toggle between data view and layout view by clicking on the data view or layout view command buttons, located in the lower-left corner of the display window (Figure 20).

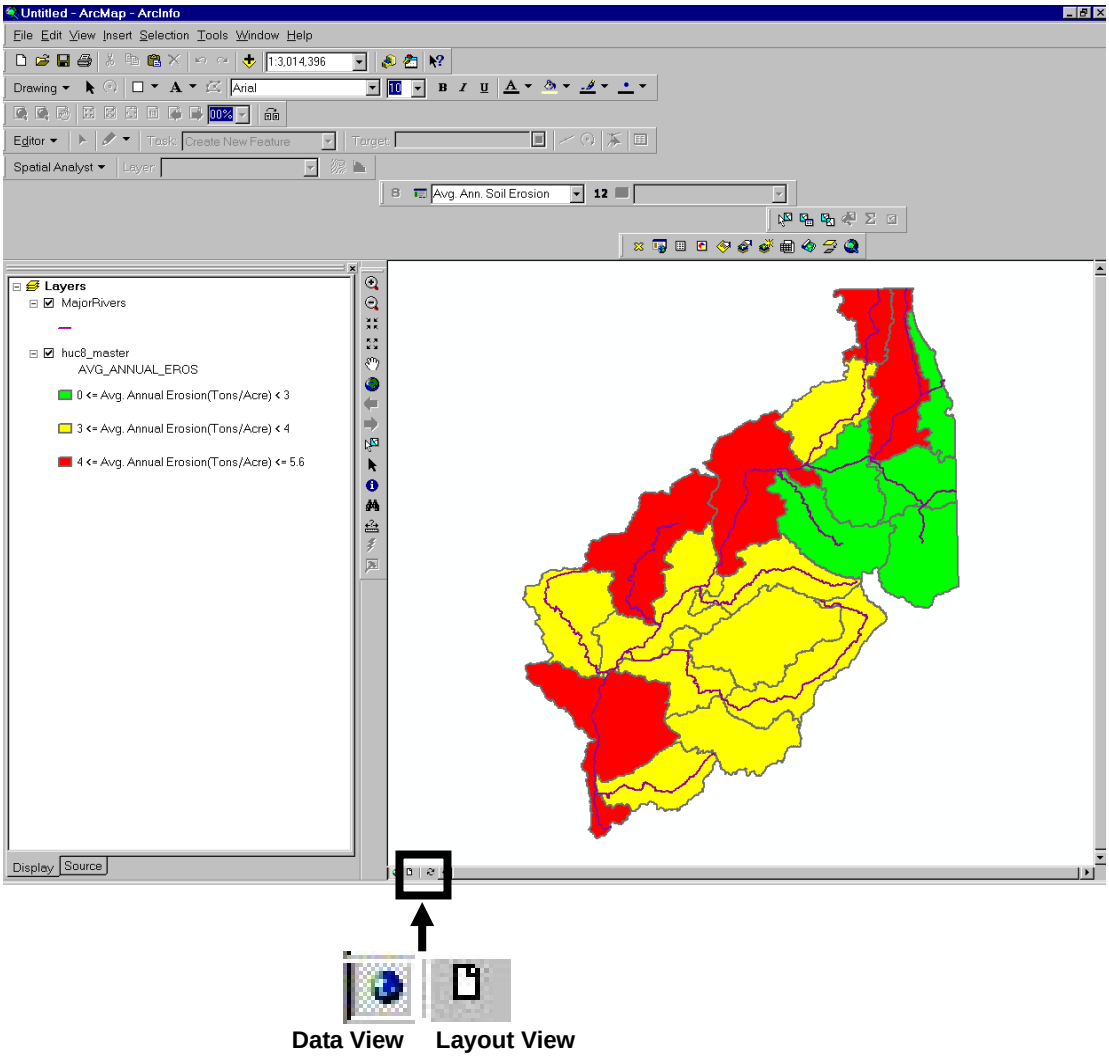


Figure 20. Data view and layout view command buttons.

Switching to layout mode automatically displays the layout toolbar (if not already displayed) and activates all of its command buttons (Figure 21). It also activates several elements under Insert Menu. Using a combination of the Insert Menu and Layout Toolbar, you can insert specific map elements and control the design and layout.

Figure 21. Layout toolbar.

The "Change Layout" command button on the Layout Toolbar (Figure 21) allows you to select predefined layouts as an option for the design and layout of your map. Predefined layouts are stored in ArcMap map templates (***.mxt**). Templates are used to store both customizations and layouts. The **IllinoisRiver_RNA.mxt** template is an example of a template that stores customizations in the support of the Illinois River RNA-GIS. In addition to this template, two additional templates have also been created (**illriver.landscape.mxt** and **illriver.portrait.mxt**) and are distributed as part of the application. These templates are for map layout purposes only and do not contain any customization related to the functionality of the application. Therefore, they should not be opened directly in the ArcGIS8.X startup dialog box. Instead, you can select these templates as an alternative template for map design and layout while in layout view within the application. They are simply templates or "starting points" for producing map output in a landscape layout (**illriver.landscape.mxt**) or portrait layout (**illriver.portrait.mxt**). By selecting one of these templates, the map layout will automatically include map elements specific to the Illinois River RNA-GIS. To select one of these templates for layout purposes while in layout view, click on the "Change Layout" command button on the Layout Toolbar (Figure 21). This will open a dialog box for selecting a layout template that is similar to the dialog box used during startup to select a template. In addition to the **illriver.portrait.mxt** and **illriver.landscape.mxt** templates, there are a variety of other predefined templates included with the standard ArcMap interface. You can select them by clicking on the various tabs across the top of the dialog box.

As mentioned above, most of the functionality of the ArcMap interface is accessible to you, regardless of whether you are operating in data view or layout view. This is also true of customizations that are unique to the Illinois River RNA-GIS, which is accessed via the **IllinoisRiver_RNA.mxt template**. For example, HUC-8 and HUC-12 map themes can be displayed and browsed while in layout view using the same procedures outlined above. Similar to data view, the contents in the active display are automatically updated in the display frame in layout view when a command or tool is executed that displays new output. However, there are some customized functions within the application that operate differently while in layout mode. They are described below.

IMPORTANT Customized Function Differences

- While in layout view, you **MUST NOT** toggle between HUC-8 and HUC-12 watershed analysis scales. If the analysis scale is changed while in layout view, the table of contents will not update properly and you will need to exit the current map document and reinitialize the application. To toggle between analysis scales, you **SHOULD ALWAYS** toggle to data view first, and then toggle analysis scales.

- If you add a new map theme to the display frame using the Select Theme for Display list box or the "Define Custom Categories for Display" command button while in layout view and a legend is included in the layout view, the legend will **NOT** automatically update, even though the display updates. To automatically update the legend, you should toggle to data view and then back to layout view again.

- While in layout view, if you execute any customized command button that requires you to use the Select HUC8/HUC12 Watershed tool, you must toggle to the data view to actually select the watershed. Command buttons that require the use of the Select HUC8/HUC12 Watershed tool include "Set Mask to Watershed Boundary," "Clip Theme to Watershed Boundary," and displaying themes by class for a specific watershed.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (From - To)
04-2004	Final	

4. TITLE AND SUBTITLE
User Manual Illinois River Restoration Needs Assessment GIS: RNA-GIS

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Scott A. Tweddale

5d. PROJECT NUMBER
Reimbursable Order No.

5e. TASK NUMBER

5f. WORK UNIT NUMBER
CNC-AQ01

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Engineer Research and Development Center (ERDC)
Construction Engineering Research Laboratory (CERL)
PO Box 9005
Champaign, IL 61826-9005

8. PERFORMING ORGANIZATION REPORT NUMBER
ERDC/CERL SR-04-5

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers
PO Box 2004
Clock Tower Building
Rock Island, IL 61204-2004

10. SPONSOR/MONITOR'S ACRONYM(S)
CEMR-PM-A

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
Copies are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

14. ABSTRACT

The Illinois River RNA-GIS application and geospatial database were developed as a tool to support the Illinois River Ecosystem Restoration Feasibility Study – Restoration Needs Assessment (RNA). Its purpose is to assist in the evaluation of historic, existing (primarily), predicted future, and desired future conditions of the Illinois River Watershed by providing an extensive geospatial database and customized GIS analytical capabilities. The study area and extent of the associated geospatial database includes the mainstream Illinois River, its tributaries, and watershed. The application is structured to provide access to GIS themes at three different scales: (1) the Illinois River Watershed, (2) the major tributary watersheds [USGS Hydrologic Unit Code-8 (HUC-8)], and (3) the subwatersheds [USGS Hydrologic Unit Code-12 (HUC-12)]. This method of organizing the application and geospatial database supports data browsing, data queries, and summaries at all scales in support of large-scale planning and smaller-scale, site-specific project formulation. The Illinois River RNA-GIS application was created using Environmental Systems Research Institute (ESRI) ArcGIS8.X® software and Microsoft's Visual Basic for Applications® (VBA), which is included with ArcGIS8.X products.

15. SUBJECT TERMS

Illinois River	Geographic Information Systems (GIS)	geospatial data
Arc GIS	watershed management	user manual

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Scott A. Tweddale
Unclassified	Unclassified	Unclassified	SAR	45	19b. TELEPHONE NUMBER (include area code) (217) 352-6511 ext 7409